



The Safety of Experimental Amateur-Built Aircraft

Purpose of the E-AB safety study

Experimental amateur-built (E-AB) aircraft represent nearly 10 percent of the U.S. general aviation fleet. These aircraft, however, accounted for approximately 15 percent of the total—and 21 percent of the fatal—U.S. general aviation accidents in 2011. Experimental amateur-built aircraft represent a growing segment of the United States' general aviation fleet—a segment that now numbers nearly 33,000 aircraft.

The National Transportation Safety Board undertook this study because of the popularity of E-AB aircraft, concerns over their safety record, and the absence of a contemporary and definitive analysis of E-AB aircraft safety. The study employed several different methods and data collection procedures to carefully examine this segment of U.S. civil aviation. This comprehensive approach resulted in a detailed characterization of the current E-AB aircraft fleet, pilot population, and associated accidents.

Areas identified for safety improvement include expanding the documentation requirements for initial aircraft airworthiness certification, verifying the completion of Phase I flight testing, improving pilots' access to transition training and supporting efforts to facilitate that training, encouraging the use of recorded data during flight testing, ensuring that buyers of used E-AB aircraft receive necessary performance documentation, and improving aircraft identification in registry records.

What the NTSB found in the study

The study compared the accident experience of E-AB aircraft with that of similar non-E-AB general aviation aircraft over the last decade. A detailed analysis was also conducted of the 224 E-AB accidents that occurred in 2011. These analyses revealed the following factors defining E-AB aircraft accidents:

- E-AB aircraft account for a disproportionate number of total accidents and an even more disproportionate share of fatal accidents when compared with similar non-E-AB aircraft conducting similar flight operations.
- Accident analyses indicate that powerplant failures and loss of control in flight are the most common E-AB aircraft accident occurrences by a large margin and that accident occurrences are similar for both new and used aircraft.
- Structural failures have not been a common occurrence among E-AB aircraft. In comparison with similar non-E-AB aircraft, a much higher proportion of accidents involving E-AB aircraft occur early in the operational life of the aircraft.
- A similarly large proportion of E-AB aircraft accidents occur shortly after being purchased by a subsequent owner. For example, 14 of the 224 study accidents during 2011 occurred during the first flight by a new owner of a used E-AB aircraft.

Through further analysis of the accident record and the results of an EAA survey of E-AB aircraft owners and builders, the study also found:

- The majority of E-AB aircraft are now built from commercial kits, rather than from purchased plans or original designs.
- Pilots of E-AB aircraft, whether involved in accidents or not, have similar, or higher, levels of total aviation experience than pilots of non-E-AB aircraft engaged in similar general aviation operations.
- Pilots of E-AB accident aircraft, on average, had significantly less flight experience in the type of aircraft they were flying than pilots of non-E-AB aircraft.

Finally, study analyses identified the following key issue areas to explain these findings and recommended actions to improve E-AB aircraft safety.

How Owners/Operators of E-AB Aircraft Can Reduce Their Chances of Being Involved in an Accident

Develop A Flight Test Plan, and Follow It

How many times have you heard the Phase I flight test period referred to as, “flying off time”? Rather than just building time, the Phase I test period is intended to 1) determine an aircraft’s airworthiness and flight characteristics, and 2) develop the operating manual needed for the future safe operation of the aircraft.

Accident case studies indicate that not all builders of E-AB aircraft create a detailed aircraft flight test plan during Phase I flight testing. Of the EAA survey respondents who had achieved airworthiness certification, only 37% claimed to have a “very detailed” flight test plan.

The Phase I flight test period is uniquely challenging for most pilots because they must learn to manage the handling characteristics of an unfamiliar aircraft while also managing the challenges of the flight test environment, including instrumentation that is not yet calibrated, controls that may need adjustment, and possible malfunctions or adverse handling characteristics.

Following a detailed flight test plan, that anticipates and limits the risks encountered during the Phase I flight testing, can reduce the likelihood of problems and better prepare you to safely handle any that occur in flight.

Create A Complete Aircraft Manual

Use the information obtained about your aircraft’s performance and operating characteristics through the flight test plan to create an accurate and complete aircraft flight manual. In addition to the safety benefits that a complete aircraft manual provides, should you ever choose to sell your aircraft, its value may be enhanced by the inclusion of a flight manual.

Test Your Aircraft’s Fuel System

A review of E-AB accident cases identifies loss of engine power as a common occurrence in E-AB accidents. In addition to ensuring that your aircraft’s engine is mechanically sound, you can reduce your accident risk by conducting a functional test of your newly built aircraft fuel system.

A functional test of the fuel system can identify design deficiencies, leaks, and malfunctions prior to flight, that would prevent fuel system- and powerplant-related accidents, which often occur early in the operational life of an aircraft. A similar test could identify deficiencies following major modifications.

Take Advantage of Training to Prepare For Phase I Flight Test Pilot Operations

Aircraft flight testing includes unique challenges and risks, and few pilots have received specific training for conducting flight tests. Owners, builders, and pilots can prepare themselves by completing flight test training to conduct Phase I test pilot functions.

The NTSB notes that the EAA periodically offers a workshop titled *Test Flying and Developing Pilot Operating Handbook*, which is focused on assisting the builder/pilot to safely explore the aircraft's flight envelope, gather and interpret flight test data and develop the aircraft flight manual. The EAA's Flight Advisor Program also provides support to the builder/pilot in developing and executing a flight test program. Builders and pilots should take advantage of educational opportunities that increase their readiness to become a test pilot.

Get Appropriate Transition Training

The study found that purchasers of used E-AB aircraft face particular challenges in transitioning to an unfamiliar E-AB aircraft. Like builders of new E-AB aircraft, they must learn to manage the unique handling characteristics of their aircraft while also learning the systems, structure, and equipment without the firsthand knowledge afforded to the builder.

The FAA advises pilots in AC90-109 that, to become familiar and competent in a new airplane, pilots should follow an organized methodology that includes the systems, procedures, performance, and limitations applicable to their aircraft. However, this guidance includes a caution that **even in simple airplanes of a similar design or even the same model, the innovation of individual designers and builders may cause problems for a pilot new to the airplane.**

Pilots who did not seek transition training were overrepresented in E-AB accidents. Subsequent owners and/or pilots of experimental airplanes, during initial flight time, had a higher accident rate than that of the original owner/pilot. Subsequent owners/pilots of experimental airplanes should receive airplane-specific training before operating the airplane.

When Purchasing a Used E-AB Aircraft, Look For a Complete Flight Manual or Take Steps to Create One

Without an appropriate aircraft flight manual, purchasers of used E-AB aircraft are not provided with sufficient information to understand the aircraft's controllability throughout all maneuvers, to detect any hazardous operating characteristics, or to understand emergency procedures. Operating an aircraft with insufficient information about its performance or operating characteristics presents a range of risks that could increase the likelihood of being involved in an accident. If you purchase a used E-AB aircraft without a detailed flight manual, develop and follow a flight test plan to create one before you engage in normal flight operations.

The complete study is available online in PDF at <http://www.nts.gov/doclib/reports/2012/SS1201.pdf>